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**MI TANK PROGRAM  
MATERIAL, SPECIFICATION  
FOR  
INSULATION SLEEVING, BOOTS AND  
TRANSITIONS, ELECTRICAL,  
HEAT SHRINKABLE  
(HIGH TEMP)**

**GDLS APPROVAL**

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**GOVERNMENT APPROVAL**

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QUALITY ASSURANCE DATE

Government Approval  
Authorized by  
ECP GDLP 5429C1

**GENERAL DYNAMICS**  
LAND SYSTEM DIVISION

MATERIAL SPECIFICATION  
FOR  
INSULATION SLEEVING, BOOTS AND TRANSITIONS,  
ELECTRICAL, HEAT SHRINKABLE (HIGH TEMP)

1. SCOPE

1.1 Scope. This specification establishes the requirements for highly flexible electrical sleeving, boots and transitions whose dimensions will reduce to a predetermined size upon application of heat in excess of 347 degrees Fahrenheit (°F)

2. APPLICABLE DOCUMENTS

2.1 Government documents. Unless otherwise specified by revision letter or 0 for initial release, the following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein. In the event of conflict between documents referenced herein and this specification, this specification shall be considered a superseding document.

SPECIFICATIONS

Federal

O-S-1926	Sodium Chloride, Technical
P-C-437	Cleaning Compound, High Pressure (steam) Cleaner
W-F-800	Fuel Oil, Diesel
W-L-800	Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature)

Military

MIL-A-8243	Anti-Icing, and Deicing-Defrosting Fluid
MIL-C-372	Cleaning Compound, Solvent for Bore of Small Arms and Automatic Aircraft Weapons
MIL-F-16884	Fuel, Diesel, Marine
MIL-H-46170	Hydraulic Fluid, Rust Inhibited, Fire-resistant, Synthetic Hydrocarbon Base
MIL-G-3056	Gasoline, Automotive, Combat
MIL-L-2 104	Lubricating Oil, Internal Combustion Engine, Heavy Duty
MIL-L-3 150	Lubricating Oil, Preservative, Medium

MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-L-46 167	Lubricating Oil, Internal Combustion Engine, Arctic
MIL-P-14232	Parts, Equipment and Tools for Materiel, Packaging of
MIL-R-46846	Rubber, Synthetic, Heat Shrinkable
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4, JP-5
MIL-W-8 1044	Wire, Electric, Cross-Linked Polyalkene, Insulated, Tin Coated Copper, Light Weight, 600 Volts, 150 Degrees C

#### STANDARDS

##### Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-45662	Calibration System Requirements

#### DRAWINGS

##### Military

10873919	Electrolyte
12273147	Boot, Adapter, Heat Shrinkable
12273148	Transition, Heat Shrinkable, 3-entry
12273162	Transition, Heat Shrinkable, 3-entry Angle
12273163	Transition, Heat Shrinkable, 4-entry
12273164	Boot, Adapter, Heat Shrinkable
12273176	Boot, Heat Shrinkable, Strain Relief, Angle
12273242	Boot, Heat Shrinkable, Strain Relief, Convolute
12287274	Adhesive

(Copies of specifications, standards, drawings, and publications required by supplier in conjunction with specified procurement functions should be obtained from the procuring activity or as directed by the **contractive** officer.)

2.2 Non-Government documents. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for approval shall apply.

American Society for Testing and Materials (ASTM)

	Standard Methods of Test for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
D412	Standard Test Methods for Rubber Properties in Tension
	Standard Methods of Test for Water Absorption of Plastics
D747	Stiffness of Plastics by Means of Cantilever Beam, Test Method for
D792	Standard Methods of Test for Specific Gravity and Density of Plastics by Displacement
	Standard Methods of Testing Nonrigid Vinyl Chloride Polymer Tubing
D2240	Standard Methods of test for Identification Hardness of Rubber and Plastics by means of a Durometer
D2671	Standard Methods of Testing Heat Shrinkable Tubing
	Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103.)

### 3 REQUIREMENTS

3.1 General material requirements. The material specified herein shall have a continuous temperature range of minus 70 to plus 302°F and meet the requirements of MIL-R-46846, Type III, for crosslinked modified viton tubing except as specified herein.

3.1.1 Character or quality. The sleeving, boots, and transitions shall not contain pin holes, tears and rips.

3.1.2 Intentionally left blank.

3.1.3 Product characteristics.

3.1.3. Color. The color of the sleeving, boots, and transitions shall be black.

3.1.3.2 Dimensions and tolerances.

3.1.3.2.1 Sleeving.

3.1.3.2.1.1 Inside diameter as supplied. The inside diameter of the sleeving, as supplied, shall be in accordance with Table I.

TABLE I. SLEEVING DIMENSIONS – AS SUPPLIED

Size	Inside Diameter Minimum	
	Inches	Millimeters
3/16	.187	4.74
1/4	.250	6.35
3/8	.375	9.50
1/2	.500	12.70
5/8	.625	15.88
3/4	.750	19.05
7/8	.875	22.23
1	1.000	25.40
1-1/4	1.250	31.75
1-1/2	1.500	38.10
2	2.000	50.80
2-1/2	2.500	63.50
3	3.000	76.20

3.1.3.2.1.2 Inside diameter and wall thickness after shrinkage. The inside diameter and wall thickness of the sleeving, after heat-shrinking by application of heat in excess of 347°F, shall be in accordance with Table II.

3.1.3.2.2 Boots. The inside diameters of boots, as supplied, shall be in accordance with drawings 12273147, 12273164, 12273176, and 12273242. Boot inside diameters, wall thicknesses, and other specified dimensions, after heat shrinking (unrestricted recovery) by application of heat in excess of 347°F, shall be in accordance with drawings 12273147, 12273164, 12273176, and 12273242.

TABLE II SLEEVING DIMENSIONS - AFTER SHRINKING

As Supplied Size (Inches)	AFTER HEAT-SHRINKING					
	Inside Diameter (Max)		Total Wall Thickness			
			Inches		Millimeters	
	Inches	Millimeters	Min.	Max.	Min.	Max.
3/16	.093	2.36	.028	.042	0.71	1.06
1/4	.125	3.17	.028	.042	0.71	1.06
3/8	.187	4.74	.028	.042	0.71	1.06
1/2	.250	6.35	.028	.042	0.71	1.06
5/8	.312	7.92	.034	.050	0.86	1.27
3/4	.375	9.50	.034	.050	0.86	1.27
7/8	.437	11.11	.035	.055	0.89	1.40
1	.500	12.70	.038	.060	0.96	1.52
1-1/4	.625	15.87	.040	.070	1.00	1.77
1-1/2	.750	19.05	.040	.070	1.00	1.77
2	1.000	25.40	.048	.082	1.21	2.08
2-1/2	1.250	31.75	.048	.082	1.21	2.08
3	1.500	38.10	.048	.082	1.21	2.08

3.1.3.2.3 Transitions. The inside diameters of transition legs, as supplied, shall be in accordance with drawings 12273148, 12273162, and 12273163. Transition leg inside diameters, wall thicknesses, and lengths, after heat shrinking (unrestricted recovery) by application of heat in excess of **347°F**, shall be in accordance with drawings 12273148, 12273162, and 12273163.

3.1.4 Physical, mechanical and electrical properties. The sleeving, boots and transitions shall exhibit the properties specified in Table III.

TABLE III. PHYSICAL, MECHANICAL AND ELECTRICAL PROPERTIES

Property	Requirement	Test procedures and conditions	
	I	Sleeving	Boots/Transitions 0.075" Thick Slab
Tensile Strength	2200 psi. min.	ASTM D2671	ASTM D412 molded slab specimen
Ultimate Elongation	350% min.	ASTM D2671	ASTM D412 molded slab specimen
Specific Gravity	1.6 max.	ASTM D792	ASTM D792
Hardness	85 ± 10 Shore A	ASTM D2240	ASTM D 2 2 4 0
Low Temperature Flexibility	No cracking	ASTM D2671 exposure at -60 ± 5°F	ASTM D2671 1/4" wide molded slab exposure at -60 ± 5°F
	6000 psi. max.	ASTM D747 1/2" wide strip	ASTM D747 1/2" wide molded strip
Heat Resistance (Tensile Strength Ultimate Elongation)	1800 psi. min. 300% min.	ASTM D2671 at 73 ± 18°F after 168 hr. exposure to 302 ± 5°F	ASTM D412 molded slab at 73 ± 18°F after 168 hr. exposure to 302 ± 5°F
Longitudinal Change	2% to -8%	MIL-R-46846	Not Required
Fungus Resistance	Rating of 1 or less	ASTM G21	ASTM G21
Water Absorption	2% max.	ASTM D570	ASTM D570
Dielectric Strength	No breakdown	ASTM D149 under oil at 200 vdc min.	ASTM D149 under oil at 200 vdc min.
Fluid Resistance	See Table IV	ASTM D570, D2671 at 73 ± 18°F after 24 hr. exposure	ASTM D570 ASTM D412 molded slab specimen 24 hr. exposure
Adhesive Compatibility	Must be compatible with with Adhesive Systems per drawing 12347278		

**TABLE IV. FLUID RESISTANCE**

Primary Fluid	Temp (±5°F)	Tensile Strength (PSI,min)	Elongation (%)	Weight Increase (% ,max)	Remarks
Gasoline MIL-G-3056	77	1000	250	25	Note 1
DF-A VV-F-800	122	1000	250	25	Note 2
Lube Oil VV-L-800	122	1000	250	25	Note 3
Synth Lube MIL-L-23699	122	1000	250	15	Note 4
Arctic Lube MIL-L-46167	122	1000	250	5	
Synth Hyd Fluid MIL-H-46170	160	1000	250	10	
Bore Cleaner MIL-C-372	122	1000	250	25	
Electrolyte P/N10873919	122	1000	250	5	Note 5
5% Salt Sol. O-S-1926	122	1000	250	5	
Cleaning Fluid P-C-437	122	1000	250	5	
Deicing Fluid MIL-A-8243	122	1000	250	5	

NOTES: 1. Gasoline/gasoline type fuel. Other fuels in category: JP-4 and JP-8, MIL-T-5624.  
 2. Diesel/kerosene fuel. Other fuels in category: DF-1 and DF-2 per Fed-STD-VV-F-800; JP-5 per MIL-T-5624; marine fuel per MIL-F-16884.  
 3. Petroleum base lubricating oil. Other fluids in category: MIL-L-2104, MIL-L-3150.  
 4. Synthetic based lubricating oil. Another fluid in this category is MIL-L-7808.  
 5. Miscellaneous or non-duplicated fluids.



## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 General.

4.1.1 Responsibility for inspection. Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all Quality Assurance Provisions specified herein (Section 4) to determine conformance with the requirements of Sections 3 and 5. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the procuring activity. The procuring activity reserves the right to perform or witness any of the inspections set forth in this document where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1.1 Inspection equipment. Unless otherwise specified in the contract, the supplier is responsible for the provision and maintenance of all inspection and test equipment necessary to assure that supplies and services conform to contract requirements. Commercial, modified commercial, or supplier designed inspection equipment or measuring set-ups must be capable of repetitive measurements to an accuracy of 10 percent of the component tolerance. Calibration of inspection and test equipment shall be in accordance with MIL-STD-45662.

4.1.2 Special tests and examinations. Special tests and examinations (see 6.3) when required, shall be performed in accordance with Table V. The inspection sequence shall be in accordance with Table V.

NOTE: Assemblies subjected to special tests and examinations shall not be used for any other purposes and shall be indelibly marked, DO NOT USE.

4.1.2.1 Preproduction. If required by the procuring activity (see 6.2) two assemblies shall be inspected by the supplier at a location approved by the procuring activity.

4.1.2.1.1 Preproduction failure. Failure of a **preproduction** assembly to meet the requirements specified herein shall be cause for cessation of inspection. When corrective measures satisfactory to the procuring activity have been taken, inspection may be continued.

4.1.2.2 Initial production. Unless otherwise specified, the procuring activity shall select two assemblies from the first 10 assemblies produced under a production contract (see 6.2). Once verification and validation of compliance with the requirements has been accomplished, quality conformance inspection of the remainder of the production contract shall be as specified (see 4.2).

4.1.2.2.1 Initial production failure. Failure of an initial production assembly during or as a result of initial production inspection shall be cause for rejection of the assembly. The procuring activity shall refuse acceptance of production assemblies until evidence of corrective action is provided.

TABLE V. CATEGORY OF INSPECTION

[illegible]

4.1.3 Quality conformance conditions & controls. Quality conformance inspections shall consist of the inspections and tests specified in Table V as indicated by the existence of an Acceptable Quality Level (AQL) or frequency of inspection number in one of the classification of characteristics columns. Examples of the number to be used are: 100%, 1.5, and 1/400. Quality conformance inspection shall be performed in accordance with the methods specified in 4.2.

NOTE:

100% means each unit produced shall be inspected for the indicated characteristics (see 4.1.3.1.2)

2. 1.5 signifies an AQL number and indicates the characteristic may be sample inspected (see 4.1.3.1.1)
3. 1/400 signifies a control inspection (see 4.1.3.2)

4.1.3.1 Lot-by-lot inspection. Lot-by-lot inspection shall consist of sampling 'and acceptance (100%) inspection as specified in Table V. An inspection lot shall consist of all assemblies of one type, submitted at one time for Quality Conformance Inspection.

4.1.3.1.1 Sampling. Sampling and inspection shall be conducted in accordance with MIL-STD-105 on the basis of percent defective for those characteristics of Table V assigned an AQL. Except as specifically designated in Table V, characteristics having the same AQL shall be treated as a group.

4.1.3.1.1.1 AOL validation. Before sampling can commence for any production contract, a minimum of 20 assemblies shall be subjected to 100% inspection to verify conformance to requirements listed in Table V. Process average for each requirement shall be computed as specified below. If the computed process average for the requirements exceed the specified AQL, 100%, inspection shall be continued until the process average for 20 consecutive assemblies is less than the specified AQL.

$$\text{Process average} = \frac{\text{Number of Defectives}}{\text{Number of Assemblies Inspected}} \times 100$$

4.1.3.1.1.2 Sampling failures. Rejected assemblies or lots shall be processed in accordance with the acceptance and rejection criteria of MIL-STD-105.

4.1.3.1.2 Acceptance (100%) inspection. For the requirements specified for acceptance (100%) inspection in Table V, each assembly of the inspection lot shall be subjected to the tests specified therein. Inspection shall be performed by the supplier at the place of manufacture except as specified in 4.1.1.

4.1.3.1.2.1 Acceptance (100%) inspection failures. Any assembly that fails to conform to any acceptance (100%) inspection shall be rejected. The rejected assembly may be repaired or corrected and resubmitted for inspection.

4.1.4 Test conditions. Unless specified, all tests shall be conducted under the following conditions:

Air temperature	73 $\pm$ 18°F
Barometric pressure	28.5 (+2.0, -3.0) inches of mercury
Relative humidity	50 $\pm$ 30 percent

4.2 Quality conformance inspection.

4.2.1 General material requirement. The sleeving, boots, and transitions shall be tested in accordance with MIL-R-46846, Type III, Class I, except as specified in 3.1 to verify conformance with 3.1.

4.2.1.1 Character or quality. The sleeving, boots, and transitions shall be visually inspected to verify 3.1.1.

4.2.1.2 Intentionally left blank.

4.2.1.3 Product characteristics.

4.2.1.3.1 Color. The sleeving, boots, and transitions shall be visually inspected to verify 3.1.3.1

4.2.1.3.2 Dimensions and tolerances.

4.2.1.3.2.1 Sleeving.

4.2.1.3.2.1.1 Inside diameter as supplied. The sleeving shall be inspected in accordance with ASTM D876 to verify conformance with 3.1.3.2.1.1.

4.2.1.3.2.1.2 Inside diameter and wall thickness after shrinkage. The sleeving shall be subjected to heat in excess of 347°F until the tubing no longer exhibits visible shrinkage (duration of exposure to heat is dependent upon tube I.D.'s and method of heat application). The completely heat-shrunk sleeving sample shall be inspected in accordance with ASTM D876 to verify the dimensional requirements of 3.1.3.2.1.2.

4.2.1.3.2.2 Boots.

4.2.1.3.2.2.1 Inside diameter as supplied. The boot shall be inspected in accordance with ASTM D876 to verify conformance with 3.1.3.2.2.

4.2.1.3.2.2.2 Inside diameter and wall thickness after shrinkage. The boot shall be subjected to heat in excess of 347°F until the boot no longer exhibits visible shrinkage (duration of exposure to heat is dependent upon I.D.'s and method of heat application). The completely heat-shrunk boot sample shall be inspected in accordance with ASTM D876 to verify the dimensional requirements of 3.1.3.2.2.

4.2.1.3.2.3 Transitions.

4.2.1.3.2.3.1 Inside diameter as supplied. The transitions shall be inspected in accordance with ASTM D876 to verify conformance with 3.1.3.2.3.

4.2.1.3.2.3.2 Inside diameter and wall thickness after shrinkage. The transitions shall be subjected to heat in excess of 347°F until the transition no longer exhibits visible shrinkage (duration of exposure to heat is dependent upon **I.D.'s** and method of heat application). The completely heat-shrunk transition sample shall be inspected in accordance with ASTM D876 to verify the dimensional requirements of 3.1.3.2.3.

4.2.1.4 Physical, mechanical, and electrical properties. The sleeving, boots and transitions shall exhibit the properties specified in Table III when tested in accordance with the properties listed therein.

4.3 Preparation for delivery. The material shall be visually inspected to verify conformance with 5.0.

## 5. PREPARATION FOR DELIVERY

5.1 General. Preparation for delivery shall be as defined in Specification MIL-R-46846 and the purchase order (see 6.2).

### 5.2 Reauirements.

5.2.1 Preservation, packaging, and packing. Unless otherwise specified, the method and materials used in preservation, packaging and packing of the assembly shall be as specified in MIL-P-14232.

## 6. NOTES

6.1 Intended use. The heat shrinkable sleeving is intended for use as a snug fitting electrical insulator.

6.2 Ordering data. Procurement documents should specify the following:

- a Title, number, and date of this specification.
- b. Applicable levels of preservation, packaging, packing, and marking instructions (see 5.1).
- c. If **preproduction** inspection is required (see 4.1.2.1).

### 6.3 Definitions.

#### 6.3.1 Special tests and examinations.

- a. Preproduction. These inspections verify a supplier's capability to produce a component to a specification and/or drawing set. The component may be built on a prototype basis without the use of production tooling. They will be normally conducted whenever a new supplier is selected.
- b. Initial production. These inspections verify the production tooling, methods, and processes used to manufacture a component. They are required on selected first articles produced in a production run. These inspections shall be repeated once every 3 years on continuing contracts.

#### 6.3.2 Quality conformance inspection.

- a Samoling. These inspections verify that physical and configuration characteristics are maintained during the production run.
- b. Control. These inspections verify that the integrity of the quality level proven by initial production inspection is maintained during the production run.
- c. Acceptance. These inspections are performed on each manufactured item to verify its functional performance against specification requirements.